

# What is a Synchrotron?

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## About Synchrotron:

- A synchrotron is a type of **circular particle accelerator**, where particles move in a loop.
- It works by **accelerating** charged particles (electrons) **through sequences of magnets until they reach almost the speed of light**.
- These fast-moving electrons **produce very bright light**, called **synchrotron light**.
- This very intense light, **predominantly in the X-ray region**, is **millions of times brighter than light** produced from **conventional sources** and 10 billion times brighter than the sun.
- The light is **channelled down beamlines to experimental workstations**, where it is used for research.
  - Scientists can use this light **to study minute matter** such as atoms and molecules.
  - They can **examine how a sample scatters, diffracts, absorbs, or reemits** the synchrotron light, which reveals various different details of structure or chemical composition.
- There are **approximately 70 synchrotrons** around the world **in various stages of development**. There are technical differences between the use and capabilities of synchrotrons, with some being used for appliances and others for fundamental/theoretical research.

## Key Facts about High Energy Photon Source (HEPS):

- **Location:** It is located approximately 50 kilometers from Beijing in Huairou, **China**.
  - The HEPS is designed to **accelerate electrons** up to energies of 6 gigaelectron volts within its **1.36-kilometer circumference storage ring**.
  - This process will **produce high-energy X-rays** that can **penetrate deep into samples, revealing intricate details at the nanometer scale**.
  - HEPS will provide researchers with **access to 14 beamlines catering to diverse fields** such as energy, condensed matter physics, materials innovation, and biomedicine.
  - **Compared to third-generation** synchrotrons like the **Shanghai Synchrotron Radiation Facility**, which boasts a circumference of 432 meters and stands as China's most advanced working synchrotron, **HEPS will offer a time resolution 10,000 times superior**.
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## Q1: What are electrons?

An electron is a subatomic particle that carries a negative electric charge. It is one of the fundamental particles that make up atoms, along with protons and neutrons. Electrons carry a fundamental electric charge, denoted as "e," which is approximately equal to  $-1.602 \times 10^{-19}$  coulombs (C).

**Source:** China inaugurates next-generation synchrotron, boasting world's brightest X-rays

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Source: <https://vajiramandravi.com/current-affairs/synchrotron/>

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